Claims

[c1] 1. A radiation imaging system comprising:

a scintillator;

an imager array; and

a lamination layer disposed between said scintillator and said imager array to provide bonding and optical coupling; said lamination layer comprising a lamination material substantially free from void spaces.

[c2] 2. The radiation imaging system in accordance with Claim 1 wherein:

said lamination layer further comprises at least about 90% of said lamination material.

[c3] 3. The radiation imaging system in accordance with Claim 1 wherein:

said lamination layer further comprises at least about 95% of said lamination material.

[c4] 4. The radiation imaging system in accordance with Claim 1 wherein:

said lamination layer further comprises at least about 99% of said lamination material.

[c5] 5. The radiation imaging system in accordance with Claim 1 further comprising a hermetic seal disposed to provide ambient moisture protection for said scintillator, said lamination layer and said imager array.

[c6] 6. The radiation imaging system in accordance with Claim 1 wherein said scintillator has a scintillator second surface that is substantially optically reflective.

[c7] 7. The radiation imaging system in accordance with Claim 1 wherein said scintillator has a thickness in a range between about 500 microns and about 25000 microns.

[c8] 8. The radiation imaging system in accordance with Claim 1 wherein said scintillator has a substantially columnar structure.

[c9]

9. The radiation imaging system in accordance with Claim 1 wherein said

lamination layer is selected from a group consisting of Benzocyclobutene (BCB) thermoset polymers, plasticized polyetherimide thermoplastic polymers having a glass transition temperature (T_g) of less than about 180 degrees C (i.e. a blend of said polyetherimide and a pentarythrytol tetrabenzoate), photodefinable BCB thermoset polymers, thermoset polymer epoxies with latent heat catalysts, thermoplastic polyester polymers and thermoplastic acrylic polymers.

[c10] 10. The radiation imaging system in accordance with Claim 9 wherein said plasticized polyetherimide thermoplastic polymers further comprise mixtures of polyetherimide and pentarythrytol tetrabenzoate, said mixtures having a range of between about 60% and about 95% by weight of said polyetherimide and a range of between about 5% to about 40% by weight of said pentarythrytol tetrabenzoate.

[c11] 11. The radiation imaging system in accordance with Claim 1 wherein said lamination layer has a thickness in a range between about 5 microns and about 25 microns.

[c12] 12. The radiation imaging system in accordance with Claim 1 wherein said lamination layer comprises an optical absorbing material which comprises an anthraquinone-based dye selected from a group consisting of diaminoanthraquinone (DAA) and 1-methylamino-4-dihydroxyanthraquinone (DHA).

[c13] 13. The radiation imaging system in accordance with Claim 12 wherein said lamination layer has a thickness in a range between about 5 microns and about 12.5 microns.

[c14] 14. The radiation imaging system in accordance with Claim 12 wherein said lamination layer comprises between about 0.5 and about 5 weight percent of said anthraquinone-based dye in said lamination material.

[c15] 15. The radiation imaging system in accordance with Claim 1 wherein said lamination layer comprises an optical absorbing material that is selected from a group consisting of sub-micron carbon powders and azo-based dyes.

[c16] 16. The radiation imaging system in accordance with Claim 15 wherein said lamination layer has a thickness in a range between about 5 microns and about 12.5 microns.

[c17] 17. The radiation imaging system in accordance with Claim 1 wherein said scintillator is a fiber optic type scintillator (FOS).

[c18] 18. A radiation imaging system comprising:
a scintillator;
an imager array; and
a lamination layer disposed between said scintillator and said imager array to provide bonding and optical coupling; said lamination layer comprising a lamination material substantially free from void spaces;
wherein said lamination layer further comprises at least about 90% of said lamination material.

[c19] 19. The radiation imaging system in accordance with Claim 18, further comprising a hermetic seal disposed to provide ambient moisture protection for said scintillator, said lamination layer and said imager array.

[c20] 20. The radiation imaging system in accordance with Claim 18, wherein said lamination layer is selected from a group consisting of Benzocyclobutene (BCB) thermoset polymers, plasticized polyetherimide thermoplastic polymers having a glass transition temperature (T_g) of less than about 180 degrees C (i.e. a blend of said polyetherimide and a pentarythrytol tetrabenzoate), photodefinable BCB thermoset polymers, thermoset polymer epoxies with latent heat catalysts, thermoplastic polyester polymers and thermoplastic acrylic polymers.

[c21] 21. The radiation imaging system in accordance with Claim 20, wherein said plasticized polyetherimide thermoplastic polymers further comprise mixtures of polyetherimide and pentarythrytol tetrabenzoate, said mixtures having a range of between about 60% and about 95% by weight of said polyetherimide and a range of between about 5% to about 40% by weight of said pentarythrytol tetrabenzoate.

[c22] 22. A method for fabricating a radiation imaging system comprising the steps of:

disposing a lamination layer between a light imager and a scintillator to form a subassembly, said light imager comprising an imager array, an intermediate imaging plate surface, and a plurality of contact pads;

subjecting said subassembly to a vacuum;

heating said subassembly to a bonding temperature;

exerting a bonding force on said subassembly; and

maintaining said vacuum, said bonding temperature and said bonding force until said light imager is bonded to said scintillator and said lamination layer comprises a lamination material that is substantially void free.

[c23] 23. The method in accordance with Claim 22, further comprising the step of soft baking said lamination layer.

[c24] 24. The method in accordance with Claim 22, wherein the step of disposing said lamination layer between said light imager and said scintillator to form said subassembly comprises the steps of:

disposing said lamination layer on said imager array, said intermediate imaging plate surface and said contact pads;

disposing said scintillator on said lamination layer so as to cover said imager array.

[c25] 25. The method in accordance with Claim 24 further comprising the step of:

removing said lamination layer from said intermediate imaging plate surface and said contact pads.

[c26] 26. The method in accordance with Claim 22 wherein the step of disposing said lamination layer between said light imager and said scintillator to form said subassembly comprises the steps of:

disposing said lamination layer on said scintillator;

disposing said lamination layer on said light imager;

positioning said scintillator so as to cover said imager array.

[c27] 27. The method in accordance with Claim 22 wherein the step of disposing said

lamination layer between said light imager and said scintillator to form said subassembly comprises the steps of:
disposing a first lamination layer portion to said light imager;
disposing a second lamination layer portion to said scintillator; and
disposing said first lamination layer portion on said second lamination layer portion at a first interface;
positioning said scintillator so as to cover said imager array.

[c28] 28. The method in accordance with Claim 22 further comprising the step of coupling a cover plate to said intermediate imaging plate surface with an adhesive ring.

[c29] 29. The method in accordance with Claim 22 wherein:
said lamination layer further comprises at least about 90% of said lamination material.

[c30] 30. The method in accordance with Claim 22 wherein:
said lamination layer further comprises at least about 95% of said lamination material.

[c31] 31. The method in accordance with Claim 22 wherein:
said lamination layer further comprises at least about 99% of said lamination material.

[c32] 32. The method in accordance with Claim 22 further comprising the step of disposing a hermetic seal so as to provide ambient moisture protection for said scintillator, said lamination layer, and said imager array.

[c33] 33. The method in accordance with Claim 22 wherein said scintillator has a scintillator second surface that is substantially optically reflective.

[c34] 34. The method in accordance with Claim 22 wherein said scintillator has a thickness in a range between about 500 microns and about 25000 microns.

[c35] 35. The method in accordance with Claim 22 wherein said scintillator has a substantially columnar structure.

[c36] 36. The method in accordance with Claim 22 wherein said imager array comprises a passivation layer, further comprising the step of disposing said lamination layer in intimate contact with said passivation layer.

[c37] 37. The method in accordance with Claim 36 wherein said passivation layer is selected from a group consisting of silicon nitride and silicon oxide.

[c38] 38. The method in accordance with Claim 22 wherein said lamination layer is selected from a group consisting of Benzocyclobutene (BCB) thermoset polymers, plasticized polyetherimide thermoplastic polymers having a glass transition temperature (T_g) of less than about 180 degrees C (i.e. a blend of said polyetherimide and a pentarythrytol tetrabenzoate), photodefinable BCB thermoset polymers, thermoset polymer epoxies with latent heat catalysts, thermoplastic polyester polymers and thermoplastic acrylic polymers.

[c39] 39. The method in accordance with Claim 38 wherein said plasticized polyetherimide thermoplastic polymers further comprise mixtures of polyetherimide and pentarythrytol tetrabenzoate, said mixtures having a range of between about 60% and about 95% by weight of said polyetherimide and a range of between about 5% to about 40% by weight of said pentarythrytol tetrabenzoate.

[c40] 40. The method in accordance with Claim 22 wherein said lamination layer has a thickness in a range between about 5 microns and about 25 microns.

[c41] 41. The method in accordance with Claim 22 wherein said lamination layer comprises an optical absorbing material which comprises an anthraquinone-based dye selected from a group consisting of diaminoanthraquinone (DAA) and 1-methylamino-4-dihydroxyanthraquinone (DHA).

[c42] 42. The method in accordance with Claim 41 wherein said lamination layer has a thickness in a range between about 5 microns and about 12.5 microns.

[c43] 43. The method in accordance with Claim 41 wherein said lamination layer comprises between about 0.5 and about 5 weight percent of said anthraquinone-based dye.

[c44] 44. The method in accordance with Claim 22 wherein said lamination layer comprises an optical absorbing material that is selected from a group consisting of sub-micron carbon powders and azo-based dyes.

[c45] 45. The method in accordance with Claim 44 wherein said lamination layer has a thickness in a range between about 5 microns and about 12.5 microns.

[c46] 46. The method in accordance with Claim 22 wherein said scintillator is a fiber optic type scintillator (FOS).

[c47]

47. A method for fabricating a radiation imaging system comprising the steps of:

disposing a lamination layer on a light imager so as to cover an imager array, an intermediate imaging plate surface and a plurality of contact pads;

disposing a scintillator first surface on said lamination layer so as to cover said imager array to produce a subassembly;

removing said lamination layer from said intermediate imaging plate surface and said contact pads;

disposing a plurality of gasket vent slits of a gasket on a vacuum tray so as to communicate with a plurality of vacuum tray vent slits;

disposing a first side of said subassembly on said gasket, so as to cover said gasket vent slits and said vacuum tray vent slits;

disposing a bladder over said subassembly and extending over said gasket to a vacuum tray periphery, so as to form a bottom chamber between said bladder and said vacuum tray;

positioning a fixture cover first side of a fixture cover to contact said bladder at said vacuum tray periphery, so as to form a top chamber between said fixture cover first side and said bladder;

placing a top foundation in contact with a fixture cover second side;

establishing a bottom chamber absolute pressure of no more than about 13 kPa;

heating said subassembly to a bonding temperature after establishing said bottom chamber absolute pressure;

pressurizing said top chamber with an inert gas, where said top chamber has an

absolute pressure in a range between about 170 kPa and about 377 kPa after said subassembly reaches said bonding temperature;
maintaining said bottom chamber absolute pressure, said bonding temperature and said top chamber absolute pressure for a bonding duration until said light imager is bonded to said scintillator to form a bonded subassembly and said lamination layer is comprised of a lamination material that is substantially free of void spaces;
restoring said bottom chamber absolute pressure and said top chamber absolute pressure to about atmospheric pressure;
cooling said bonded subassembly, said gasket, said fixture cover, and said bladder to a safe handling temperature;
removing said fixture cover and said bladder;
removing said bonded subassembly and said gasket from said vacuum tray; and
removing said gasket from said light imager.

[c48] 48. The method in accordance with Claim 47 wherein said gasket and said bladder are comprised of a polyimide film.

[c49] 49. The method in accordance with Claim 47 further comprising the step of:
disposing an adhesive ring on said intermediate imaging plate surface; and
coupling a cover plate to said intermediate imaging plate surface with said adhesive ring, so as to position said cover plate in proximity to, about 25 microns to about 50 microns, said scintillator second surface.

[c50] 50. The method in accordance with Claim 47 further comprising the step of:
disposing an adhesive ring on said intermediate imaging plate surface;
coupling a cover plate to said intermediate imaging plate surface with said adhesive ring, so as to position said cover plate in contact with said scintillator second surface.